DISTRIBUTION OF COMMON ZOOPLANKTON IN RAZOR CLAM (Solen sp.) AREA AT KUCHING BAY, SARAWAK

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Bachelor of Science with Honours (Aquatic Resource Science and Management) 2005
DISTRIBUTION OF COMMON ZOOPLANKTON IN
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This project is submitted in partial fulfillment of
the requirements for the degree of Bachelor of Science with Honours
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Distribution of Common Zooplankton in Razor Clam (Solen Sp.) area at Kuching Bay, Sarawak.

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ABSTRACT

A study on the distribution of common zooplankton in razor clam (Solen sp.) area was carried out at all tide zones in the Kuching Bay of Sarawak. The primary aim of this study was to find out the distribution of common zooplankton and its relation to the physico-chemical of the water. As results, 79 species and about 58 families were identified. These species group were commonly found highly distributed at all the study area included: Oithona spp., Pseudocalamus spp., Paracalanus spp., Thespesiopsis spp., nauphli copepods and Cerviniopsis spp. However, Oithona spp. was the most abundance genera group found highly distributed with higher percentages values. The density of zooplanktons ranged between 77.25 to 252.75 ind/l. The distributions of common zooplanktons in razor clams area at Kuching bay of Sarawak were influenced by temperature, pH and water transparency. Abundance and density of zooplanktons can be use for future research and as a basic database for future biological programme planning.

Key words: zooplanktons, physico-chemical parameter

ABSTRAK


Kata kunci: zooplankton, parameter fiziko-kimia
1.0 INTRODUCTION

The plankton community is a heterogeneous group of tiny plants (phytoplankton) and animals (zooplankton) adapted to suspension in the sea and freshwater area (Battish, 1992). Zooplankton may glide or dart about through the use of cilia (hair-like extensions from the cell surface), body undulations, or swimming appendages. Planktonic organisms are those that live floating in the water column and that are sufficiently small and/or slow so as to be incapable of directed swimming. Thus, their distribution considered controlled by physical processes, such as water currents and turbulent mixing. In addition, plankton can be divided further based on their nutritional modality. Some of the larger zooplankton may see include mysids, shrimps, chaetognatha (glass or arrow worms), coelenterate medusae, and copepoda. The copepoda are among the most common of zooplankton and use their antennae to swim; in fact, the word copepod is derived from Greek, meaning, “oar-foot” (Pipkin, 1977).

Zooplankton can be divided into a few different types of group such as microcrustacea, rotifers, coelenterates, ctenophores, annelids, and mollusc (Parry, 1992). Other zooplankton is single-celled animals, like foraminifera and radiolarians. Other zooplankton is tiny crustaceans, like Daphnia. Crustaceans are the main group, making up about 70% of zooplankton species. Meroplankton spends only part of their lives in the pelagial; and mostly eggs and larvae of benthic invertebrates and of fish such as snail veliger, polychaete larva, starfish larva, sea urchin larva, barnacle nauplius, barnacle cyprid, crab zoea and crab megalopa (Deibel, 1992). The
mesozooplankton are the primary consumers of phytoplankton among the oceanic plankton. They are important in the energy economy of the sea, forming a vital connection between the phytoplankton at the base of the food web and the "higher" consumer levels including finfish, shellfish, birds and mammals (Deibel, 1992). Although the zooplanktons do not contain as many species as does the zoobenthos (May, 1988), if both holoplankton and meroplanktonic larval stages include in the meso- and macrozooplankton, then most invertebrate phyla are represented. These phyla include over 4,000 species and inhabit one of the largest 3-dimensional environments on the planet such as the world ocean, covering 70% of the earth's surface and extending to depths of greater than 11 km (Deibel, 1992).

The arthropods, which include the abundant and diverse copepods, contain ca. 66% of the total mesozooplankton species (Deibel, 1992). Detectable changes in the abundance or species composition of mesozooplankton may reflect fundamental changes in the ocean environment affecting phytoplankton (Clark, 1992). Zooplankton are eaten by larger animals, some of which are of commercial importance, changes in zooplankton communities can provide early indications of imminent changes in the food conditions for fish, birds and mammals. In summary, because of their rich species diversity, because of the vast volume of water which they inhabit, because of their keystone trophodynamic role and because they include the meroplanktonic stages of benthic organisms, the meso- and macrozooplankton should be included in any monitoring and biodiversity assessment network (Deibel, 1992). Zooplankton forms the vital links in the pelagic food chain. Many micro zooplankters also constitute the major food item of the larvae of crustaceans, molluscs, and fishes.
Thus abundance of zooplankton practically acts as an ideal index to assess the fertility of water mass (Mishra et al., 1998). Mostly zooplankton species found inhabit the shallow and near to surface area.

Zooplankton consists of primer user in the sea. Their range size is much larger and more complex than phytoplankton species, even though mostly zooplankton is microscopic to partially microscopic. Species composition and abundance of zooplankton communities can be influenced by a number of physical, chemical and biological factors. In a general way, factors such as temperature, salinity, pH and electrical conductivity can affect this community with regard to both composition and population density (Sampaio, et al., 2002). The size of the water bodies, their trophic state and the successional stage also greatly influences the species composition of the zooplankton (Sampaio, et al., 2002). In natural environments these factors act simultaneously and may also interact to different degrees, modifying the zooplankton structure in different ways. There are many invertebrate species that possess their larvae level as a planktonic, where mostly from the other animal, they floating, and influence by current for whole of their life cycle. The ability of zooplankton to move vertically is the most important character they possess.

They usually move upward to the surface during the day and move downward when the night came. Even though migration is faster and wide range of ocean environment is the same, there's also a physical, chemical and biology factors that causes most of these species distribution are limited. Only a small amount of these species assumed distribute to all over the world's ocean. Variance in abundance is
greatest along these physical gradients (Deibel, 1992). Therefore, to reduce between sample variations and to determine the effect of these various factors on meso- and macrozooplankton abundance, a stratified random design is commonly employed. The "strata" are simply sub-divisions of the total area of an investigation. These strata are often defined by the above physical characteristics (Deibel, 1992). For example, although zooplanktons are not geographically resident fauna unlike the zoobenthos, they are certainly hydrographically resident fauna, meaning that all taxa have preferred limits of temperature and salinity within which they commonly live. Thus, strata are often chosen that have relatively uniform hydrographic characteristics, for example the upper mixed layer, the thermocline/ pycnocline, and the bottom mixed layer (Deibel, 1992).

Variance in zooplankton species composition and abundance is usually less within these strata than between strata. Hydrographic characteristics can also vary on a larger spatial scale along onshore-offshore transects, with strong changes in the zooplankton community as one proceeds offshore, where water depth is greater (Deibel, 1992). Consequently, another way to stratify a sampling plan may be along an onshore-offshore gradient. However, zooplankton also varies a great deal temporally. Sampling may be stratified on short time scales (day vs. night), medium time scales (before and after storm events), seasonal time scales (spring bloom vs. summer conditions) and decadal time scales (large scale time series). Day verses nighttime scales are important because many zooplanktons undertake diel vertical migrations over tens to several hundreds of meters. The storm frequency is important because wind mixing can disturb buoyancy-driven hydrographic structure, leading to
a marked increase in the variability of zooplankton tows within a given stratum (Deibel, 1992). For example, Cassie (1963) found the coefficient of variation (standard deviation / mean) of replicate zooplankton tows to range from 15-70% in calm seas, but to reach 300% during storms. The seasonal time scale is important because many zooplanktons grow and reproduce in response to the seasonal cycle of light, heat and food, and because the upper water column often stabilizes in summer, remaining relatively isolated from deeper water until the breakdown of stability in the fall.

The decadal time scale is important because this is the time scale over which we are most likely to detect changes in species abundance and composition in response to global change (Deibel, 1992). In summary, the best rule of thumb is to take more samples when zooplankton abundance is changing most rapidly and is most variable and fewer samples when change is more gradual. While for the temperature, it controls the reproductive rate, population size and metabolism of many species (Sampaio, et al., 2002). Quality and quantity of food can alter species composition as well as the abundance of the species, since particular organisms are highly selective about the size and the type of phytoplankton they eat (Sampaio, et al., 2002). Predation by fish may affect zooplankton structure, in accordance with the fish feeding mode: selective feeders, by differential capture of organisms, tend to eliminate large species, which are replaced by less vulnerable small forms (Sampaio, et al., 2002); filter-feeding planktophage fishes do not actively select their preys and therefore more evasive species avoid predation whereas small forms are captured, thus diminishing zooplankton densities (Sampaio, et al., 2002).
However, zooplanktons study in Sarawak is still below expectation, therefore the objectives of the present study are:

1. To study the distribution of zooplankton from Mean Low Water Neap to Mean High Water Neap low tide in the razor clam (*Solen* sp.) area at Kuching Bay Sarawak.

2. To identify the zooplankton species composition in the razor clam (*Solen* sp.) area at Kuching Bay Sarawak.

3. To determine the zooplankton species density in the razor clam (*Solen* sp.) area at Kuching Bay Sarawak.

4. To determine the physico-chemical factors that influence zooplankton distribution in the razor clam (*Solen* sp.) area at Kuching Bay Sarawak.
2.0 MATERIALS AND METHOD:

2.1 Study area

This study has been carried out at the razor clam area in Asajaya Laut and Pasir Puteh. The samples have been taken three times where first and second samples collecting, has been carried out at Kampung Asajaya Laut (Station 1) situated at (N 1°35'52" and E 110°36'21.7") on the August 11th and September 16th 2004. Then the third sampling has been carried out at Kampung Pasir Puteh (Station 2) situated at (N 01°39' 51.6", E 110°30' 00.3") on the February 5th 2005. Both of these stations are located near the estuarine and the water conditions are less wave action before the razor clams season and heavy wave action during the razor clams season at Asajaya Laut and Pasir Puteh. This study has been carried out at the three zone in low tide zone, mid tide zone, and high tide zone, where two samples was taken from each site using the van dorn bottle and one sample was taken using the 45 µm plankton net.
Figure 1: Map showing the location of study area at Kampung Asajaya Laut, Sadong Jaya (Station 1)

Figure 2: Map showing the location of study area at Kampung Pasir Puteh, Muara Tebas (Station 2)
2.2 Field Sampling

2.2.1 Zooplankton study

Zooplankton samples were collected at the low tide, mid tide and high tide zones that had been selected located at Asajaya Laut and Pasir Putih, during the flood seasons when the water covers the beach. Sampling was done before and during the razor clams season at Asajaya Laut and only during the razor clams season at Pasir Putih. There were two sampling done at Asajaya Laut while one at Pasir Putih. Samples were collected for qualitative and quantitative study, where for quantitative study (density), water samples have been collected by using the Van Dorn bottles. While for qualitative study (species composition), plankton net has been used. Samples from the Van Dorn bottles were sieved through a 45µm mesh sieves on the boat and the zooplankton retained on the sieve were preserved in 5% neutralized formalin (Zmarzly, et al., 1994). While the plankton net 75µm, been pull vertically for about 5 minutes for accurate collected samples of zooplankton species distributed within the area. The coordinates of these stations were determined using map and Global Positioning System (GPS).

2.2.2 Physicochemical Factor

The physicochemical parameters such as temperature, salinity, DO, pH, and water transparency was measured in situ by using the portable meter such as, salinity (Refractometer model Atago S-28), Dissolved oxygen and temperature (Cyber scan
meter model DO200 series), pH (pH meter model Jenway 30TI) and water transparency (Secchi disc).

2.3 Sorting and counting

During the laboratory work, all the samples were extracted by sorting out between zooplankton species and the other species exists. Then the zooplankton species were sorting within their groups. Group of zooplanktons was sorted into different group of specimen all look-alikes and count the total (densities) of them.

2.4 Identification of Zooplanktons

For identification of zooplankton species, the sample was taken out and placed inside the petri dish. Compound microscope was used to identify to the lowest practical taxon. Zooplankton identification was followed the key by "A Guide to Marine Coastal Plankton and Marine Invertebrate Larvae" (Smith, 1977); "Coastal marine zooplankton: a practical manual for students" the 2nd Edition by Todd, Laverack & Boxshall, 1996; "Copepod Evolution" (Huys & Boxshall, 1991).

2.5 Data Analysis

Correlation analysis has been applied to determine the relationship between zooplanktons and physico-chemical parameter by using the Statistic Package for
Social Science Version 11.5. Species diversity ($H'$), species evenness ($J'$) and species richness (SR) were calculated for each station using the following equations:

Margelaf Index ($D$); (Margalef, 1958)

$$D = \frac{(S-1)}{\ln N}$$

Where $S$ is the total number of species in a sample, and $N$ is the total number of individual in a sample.

Shannon-Weaver ($H'$); (Pielou, 1975)

$$H' = - \sum (P_i \log_2 P_i)$$

$$H' = - \sum \left(\frac{n_i}{N}\right) \log_2 \left(\frac{n_i}{N}\right)$$

Where $n_i$ is the total number of individual for each species $i$, $N$ is the total number of individual in a sample and $P_i$ is equal to $n_i / N$.

Pielou Similarity Index ($J$); (Pielou, 1975)

$$J = \frac{H'}{H'_{max}}$$

$$J = \frac{H'}{\log_2 S}$$

Where $H'$ is the species diversity, and $S$ is the total number of species in a sample.
3.0 RESULTS

3.1 Physico-chemical parameters

The variations of physico-chemical parameters at study area are summarized in Table 1. The temperature values at all tide zones are in the range of 23.4°C to 27.4°C (Table 1). The highest temperature was recorded at the mid tide zones during the razor clams season at Asajaya Laut (27.4°C), while the lowest was recorded also during the razor clams season at Asajaya Laut at the high tide zones (23.4°C). Salinities values for each tide zones are consistent and did not show much difference (Table 1). Salinity values found highest at the low tide and mid tide zones (28 psu) before the razor clams season at Asajaya Laut and the lowest recorded at the high tide zones (11 psu) during the razor clams season at Asajaya Laut.

Dissolved oxygen content for all tide zone are inconsistent which, ranged from 5.52mg/m³ to 8.81mg/m³. The highest dissolved oxygen was recorded at the mid tide zone before the razor clams season in Asajaya Laut (8.81mg/m³) and the lowest recorded at the mid tide zones during the razor clams season in Asajaya Laut. Meanwhile pH values was recorded highest at the high tide zones during the razor clams season in Pasir Puteh and the lowest values was collected at the low tide zones before the razor clams season in Asajaya Laut. While for the water transparency parameter, maximum values (154cm) was recorded at the low tide zones before the razor clams season in Asajaya Laut and minimum values (9.8cm) recorded at the high tide zones during the razor clams season in Asajaya Laut.
Table 1: Physico-chemical parameter reading for each station

<table>
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<tr>
<th>Sampling Parameter</th>
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<th>During razor clam’s seasons at Asajaya Laut</th>
<th>During razor clam’s season at Pasir Puteh</th>
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<tr>
<td></td>
<td>Low Tide Zone</td>
<td>Mid Tide Zone</td>
<td>High Tide Zone</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>26.4</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>Salinity (psu)</td>
<td>28</td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td>DO (mg/m³)</td>
<td>8.15</td>
<td>8.81</td>
<td>7.52</td>
</tr>
<tr>
<td>pH</td>
<td>7.13</td>
<td>7.41</td>
<td>7.25</td>
</tr>
<tr>
<td>Transparency (cm)</td>
<td>154</td>
<td>128</td>
<td>111</td>
</tr>
</tbody>
</table>

Notes: DO-dissolved oxygen
3.2 Zooplanktons

3.2.1 Species composition


Species with their abundance more than 1% are considered common and less than 1% are considered rare. They were fourteen species commonly found before the razor clam's season (Table 3). They were *Oithona* spp. (20.65%), *Pseudocalanus* spp. (16.91%), *Paracalanus* spp. (14.04%), *Ameira* spp. (11.4%), *Thespesiopsyllus* spp. (7.1%), nauplii copepods (4.71%), polychaete larvae (3.43%), *Cerviniopsis* spp. (2.79%), *Oikopleura* spp. (2.79%), *Cyclopinodes* spp. (2.55%), *Ecbathyron* spp. (1.99%), euphausiids larvae (1.59%), *Centropages* spp. (1.19%), and *Calanus* spp. (1.19%). Meanwhile others were (7.67%) referred to other species group that less than 1%. They were spionid larvae, *Temora* spp., *Semibalanus* spp., *Tisbe* spp., bivalve larvae, *Lanice* spp., *Macrocypris* spp., *Carcinus* spp., *Lucifer* spp., *Necora* spp., *Candacia* spp., *Ophiodromus* spp., *Halitholus* spp., *Metridia* spp., *Polydora* spp., *Processa* spp., *Longipedia* spp., *Microcalanus* spp., *Enhydrosoma* spp., *Phyllodoca* spp., and *Pseudoamphiascopsis* spp. (Appendix 2).